Milk and Microbiology

Milk is valued according to its CONTENT and CLEANLINESS.

Milk is tested regularly. The results are used to calculate its value using the **Milk Equation**.

Payment per litre	=	% Butterfat content	+	% Protein content	-	Hygiene Grade *	-	Cell Count* *

An example for September 2007:

19.44p/L	=	4% butterfat content	+	3.3% protein	-	Hygiene Grade	-	Cell Count

• Milk is valued on its <u>content</u> and <u>cleanliness</u>. Two <u>hygiene</u> scales operate:

<u>Scale 1.</u> <u>Cell Count</u> * * (Somatic cell count for Mastitis, a common infection of the udder)
Category 1. - Less than 200,000 cells - no deduction
Category 2. – 200,001 to 250,000 cells - a deduction of 0.2p a litre
Category 3. - 250,001 to 400,000 cells - a deduction of 0.5p a litre
Category 4. - Over 400,00 cells – the dairy will not buy the milk

<u>Scale 2.</u> <u>Hygiene Grade</u> * (bacterial count, known as "Bactoscan")
Grade A - 0 to 60,000 – no reduction
Grade B - 61,000 to 100,000 - a deduction of 0.2p a litre
Grade C - 101,000 to 250,000 - a deduction of 0.5p a litre
Grade D – 251,000 to 400,000 - a deduction of 2.0p a litre

Milk is *'manufactured'* by the cow and leaves the farm by a milk tanker.
Between the cow and the tanker a strict hygiene routine is followed to ensure the milk is Category 1, Grade A.

<u>MILK YIELD</u>

A cow produces milk over a 305 day period known as the lactation cycle.

The National performance figures (per cow) for Holstein - Friesian are:

Low	Average	High	Very High
5725 Litres	6650 Litres	7575 Litres	8500 Litres

What is the expected yield from Garston's herd? _____

How much is the farm paid per litre? _____

2007 Sparsholt Dairy - milk content and cleanliness results

Spring / Summer 2007	Butterfat [%]	Protein [%]	Cell Count [000's/ml]	BactoScan [000's/ml]	Extraneous Water	Antibiotic	Urea [mg/l]
14 January 2007	4.42	3.25	169	19	No	Negative	362
07 February 2007	4.14	3.36	203	15	No	Negative	275
12 February 2007	4.02	3.37	178	15	No	Negative	291
20 February 2007	4.17	3.32	217	28	No	Negative	251
06 March 2007	4.06	3.24	176	51	No	Negative	166
15 March 2007	4.13	3.35	221	16	No	Negative	271
22 March 2007	4.42	3.31	188	17	No	Negative	223
31 March 2007	4.25	3.4	216	30	No	Negative	288
10 April 2007	4.37	3.36	242	34	No	Negative	293
23 April 2007	4.07	3.36	232	34	No	Negative	234
29 April 2007	4.03	3.34	316	48	No	Negative	220
07 May 2007	4.25	3.36	251	22	No	Negative	233
04 June 2007	4.18	3.24	299	53	No	Negative	282

Autumn 2007	Butterfat [%]	Protein [%]	Cell Count [000's/ml]	BactoScan [000's/ml]	Extraneous Water	Antibiotic	Urea [mg/l]
30 October 2007	4.54	3.29	238	28	No	Negative	298
08 November 2007	4.52	3.23	227	14	No	Negative	272
14 November 2007	4.4	3.25	195	52	No	Negative	236
27 November 2007	4.3	3.25	214	error	No	Negative	355
06 December 2007	4.28	3.18	217	70	No	Negative	277

Spring 2008	Butterfat [%]	Protein [%]	Cell Count [000's/ml]	BactoScan [000's/ml]	Extraneous Water	Antibiotic	Urea [mg/l]
07 January 2008	4.12	3.15	227	38	No	Negative	284
25 February 2008	4.32	3.21	203	19	No	Negative	276
04 March 2008	4.46	3.21	277	16	No	Negative	264

2006 Sparsholt Dairy - milk content and cleanliness results

SPRING 2006 (Sample date)	Butterfat [%]	Protein [%]	Cell Count [000's/ml]	BactoScan [000's/ml]	Extraneous Water	Antibiotic	Urea [mg/l]
25 September 2005	4.22	3.46	210	16	No	Negative	-
27 October 2005	4.22	3.42	213	20	No	Negative	222
06 November 2005	4.3	3.39	213	25	No	Negative	188
04 December 2005	4.19	3.44	271	26	No	Negative	240
27 March 2006	4.44	3.37	184	14	No	Negative	269
02 April 2006	4.36	3.46	315	21	No	Negative	281
11 April 2006	4.32	3.46	192	12	No	Negative	296

AUTUMN 2006	Butterfat [%]	Protein [%]	Cell Count [000's/ml]	BactoScan [000's/ml]	Extraneous Water	Antibiotic	Urea [mg/l]
11 September 2006	4.41	3.41	175	15	No	Negative	306
17 September 2006	4.55	3.4	237	17	No	Negative	288
26 September 2006	4.42	3.38	189	15	No	Negative	268
10 October 2006	4.42	3.41	183	98	No	Negative	146
09 November 2006	4.28	3.47	174	37	No	Negative	254
14 November 2006	4.19	3.45	225	14	No	Negative	352
27 November 2006	4.19	3.39	164	28	No	Negative	348
06 December 2006	4.27	3.41	188	68	No	Negative	324
11 December 2006	4.18	3.43	184	99	No	Negative	323
17 December 2006	4.41	3.37	210	19	No	Negative	374
26 December 2006	4.41	3.31	161	19	No	Negative	287

Applied Science GCSE Microbiology

Which antibiotic was most effective at treating the bacteria *Stapylococcus aureus?*

The 12 different antibiotics used are listed below. The zone of inhibition can be measured for each different antibiotic.

Disc Code	Antibiotic	Level	Zone of inhibition (mm)
AML 25	**Amoxycilin**	**25µg**	
C 10	**Chloramphenicol**	**10µg**	
CL 30	**Cephalexin**	**30µg**	
CN 30	**Gentamycin**	**30µg**	
E 5	**Erthromycin**	**5µg**	
N 10	**Neomycin**	**10µg**	
OA 2	**Oxylinic Acid**	**2µg**	
P 2	**Penicillin G**	**2units**	
S 3 300	**Compound Sulphonamides**	**300µg**	
SXT 25	**Sulphamethoxazole / Trimethoprim**	**25µg**	
UB 30	**Flumequine**	**30µg**	
TE10	**Tetracycline**	**10 µg**	

Milk and Microbiology

1 Investigate the quality of Sparsholt milk.

- Test Sparsholt milk for bacteria types/numbers
- Practise aseptic techniques
- Carry out a serial dilution of a milk sample
- Inoculate agar plates
- Calculate the bacterial cell count of milk
- Consider the effect of antibiotics

Note: Sealed plates are usually taken back to school for incubation and colony counts.

2 Investigate Dairy Farming – an example of intensive farming

- Lactation cycle. Why do cows produce milk?
- Visit a modern milking parlour, see milking in action – try for yourselves.
- Outcomes of milk production – meet the calves!
- Consider anti-bacterial procedures and equipment for clean milk. Observe and then join in milking: wiping teats, testing for mastitis etc (Milking starts at about 1.45pm)
- Treatment of milk – heat exchange, refrigeration. When is the milk collected? Where does the milk go? What is it used for?
- Visit silage clamps to consider role of bacteria in silage (winter cattle feed). Milk yield is also affected by the quality of cattle feed as well as genetics!
- How are cattle kept healthy indoors in winter? How can the waste be managed? Consider the role of micro organisms in waste management/ breaking down farmyard manure. How is it disposed of? Is this system sustainable?
- Observe computer with milk records upstairs. Look at the milk price and milk quality (protein, Bactoscan and somatic cell count) on notice board in milking gallery. How much is the farm paid per litre of milk?

3 Investigate the effect of selective breeding of Dairy Cows

- Why select? What important characteristics are we breeding for?
- Investigate the effect of selection on milk yields
- Consider health & quality of breeding stock. Select the breeding stock- meet cows.
- Important characteristics of breeding stock: choose a bull. Dairy or beef?
- Outcomes of different genetic crosses – visit dairy & beef calves
- Investigate the quality and price of Sparsholt milk. Observe milk records on board and computers in gallery.

GCSE Applied Science Milk and Microbiology

Suggested preparation activities:

1 Carry out a Risk Assessment of the dairy by looking at the website: www.sparsholtschoolscentre.org.uk. Look at the "virtual tour" "east" or "dairy" then "the Story of Milk". Think about:

a. Physical risk near large animals

b. Biological risk eg bacteria.

- how to prevent bacteria from manure contaminating the milk
- how to prevent bacteria from a cow who has an infection in her udder (such as mastitis) from contaminating the milk
- how to prevent cross contamination between cows
- how to prevent bacteria from manure/ cows/ calves from contaminating pupils ! (eg by not eating on the farm, wearing coats, bringing a change of footwear, washing hands thoroughly etc)

c H&S procedures – what can pupils suggest? (eg gloves, aprons, disinfectant wipes, filter, sterilising milking equipment.)

NB Some groups do actually visit the milking parlour to write their own R.A. as the first activity of the day.

2 Make sure all pupils know what to bring/ not to bring by looking on the web site at "Secondary schools", "Pupil Resources", "What to Bring". What clothes are suitable for a lab and for a farm? How can you be sure you will not transmit any disease to yourself? (This follows on from number 1b)

3 Discuss the technique of serial dilution as in Folens *GCSE in Applied Science* page IV35 Unit 1, Assignment 3 Investigating microorganisms. Pupils will carry out a serial dilution of milk from the Sparsholt cows in the Lab and it is helpful if they understand the reasons for this and the multiplication to get meaningful results.

4 Use a food technology area to set up a culture to produce yoghurt, which can then be consumed by pupils. Other schools have found this a popular activity! This can lead on to the identification of beneficial and harmful microorganisms. Pupils will discover examples of these around the farm. For example *Lactobacillus plantarum* is used to treat grass or maize forage to convert it into silage (pickled grass/ maize) to preserve the cows food over winter. Cow manure decays due to the action of microorganisms and is converted into a useful organic fertiliser.

5 Pupils could be encouraged to carry out their own supermarket survey of dairy products. Look for different sorts of milk and other dairy products. These could be related to healthy diets: fat and protein content etc. A tasting session could be popular! (Sparsholt milk currently goes to Watson's Dairy, Soberton, Southampton.) www.milk.co.uk could be worth looking at.

6 Encourage pupils to explore the "secondary pupils" "science KS4" section of the Sparsholt Schools' Centre web site to find out more about dairy farming.